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MACHINE TOOLS AND METALWORKING EQUIPMENT

No. 11

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Machine Tools and Metalworking Equipment

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AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

ROBOTICS

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MACHINE TOOL INDUSTRY OFFICIALS STRESS PRODUCTIVITY THROUGH AUTOMATION

Moscow MASHINOSTROITEL' in Russian No 3, Mar 83 pp 1-2

[Article by V. M. Grigor'yev, secretary, Central Committee, Trade Union of Workers in Machine and Instrument Building: "Reserves for Growth in Labor Productivity"]

[Text] The 26th CPSU Congress posed specific tasks in the further improvement of labor protection at production operations, the creation of the necessary conditions for improving its protection and the reduction of manual, low skilled and heavy physical labor. These tasks should be solved through the comprehensive mechanization and automation of production processes, the creation of safe technology and supplying equipment with the means of protecting people from the effects of dangerous and harmful elements of production. The congress pointed out that it is essential to substantially increase the production of machinery and equipment systems, automatic manipulators with program control, making it possible to eliminate the use of manual, low skilled and monotonous labor, especially in heavy and harmful conditions.

Taking these tasks into consideration, the machine and instrument building sectors are conducting systematic work to reduce manual labor in main and auxiliary production, to mechanize and automate it and to improve equipment and processes. All this will not only help improve labor productivity, but also qualitatively change its content, transforming it into inspired and skilled labor, giving people a feeling of satisfaction.

Until recently these problems were not given the necessary attention on the part of economic and trade union organs. Only after the acceptance of the CPSU Central Committee and USSR Council of Ministers Decree: "On the Further Development of Machine Building during 1978-1980", did the sectors develop and deliver to collectives at production associations, enterprises and organization targeted comprehensive programs for the reduction of manual labor which are now being implemented. As a result of this program during the 11th Five-Year Plan there will be a marked reduction in the use of manual labor at machine and instrument building enterprises. Calculations show that the USSR Gosplan targets for 1981-1985 with respect to reductions in the number of workers engaged in manual labor might be exceeded. Already the ministries have found the possibilities of overfulfilling these targets by 17,000 people.

However, the experience of recent years shows that manual labor can only be successfully reduced by the daily painstaking work of economic managers, trade union committees and primary organizations and administrations of NTO [Scientific-technical societies]and VOIR. Maximum effort should be directed towards the implementation, within the timeframe established, of the comprehensive plans for the improvement of labor conditions and protection and the sanitation measures for 1981-1985. These plans make provisions for the improvement of working conditions and the reduction of the number of people engaged in manual labor, above all heavy physical labor and for the complete liberation of women from this work.

Work targeted towards the mechanization of manual labor is being conducted at the Forge-Press Equipment Plant imeni M. I. Kalinin in Voronezh.

The casting operation here has given up the traditional cupolas, replacing them with electric furnaces. This has made it possible to mechanize one of the most labor intensive operations -- the shake-out of large castings from the molding box. A telescopic roller roof, flow-exhaust ventilation and scrubbers for exhaust gases and dust have been installed here. This system also includes equipment for collecting ash and dirt and a conveyor belt equiped with an exhaust ventilator. The result is a considerable improvement in working conditions at the shop. The economic effect from the introduction of the equipment is 13,000 rubles annually.

The introduction of a mechanized, continuously operating device for preparatory work using self-hardening mixtures has improved production standards and sanitary-hygienic conditions. It has eliminated the use of vibrators and dozens of form workers have been released from manual labor. Labor productivity has increased 1.5 - 2 fold and the annual economic effect is about 25,000 rubles.

Much is being done at this plant to mechanize auxiliary operations. Around 200 freight lifting and transport machines are annually introduced and the non-transfer containerized transport of parts and blanks is widely used. There are now about 3,000 different containers and 12 mechanized warehouses working in manufacturing operations. They have released 90 people from manual labor. At present loading-unloading, warehouse and transport operations are 86.2 percent mechanized.

The initiative of workers in Zaporozhye Oblast: "Manual Labor -- On the Shoulders of Machines" has received widespread dissemination at machine and instrument building enterprises.

For example, during the 11th Five-Year Plan at the Petrodvortsoviy Watch Plant, Leningrad Production Association, a comprehensive targeted program provides for the mechanization of the monotonous manual labor of 580 watch assemblers and inspectors. The work of 220 people has already been mechanized and in 1 year alone 150 assemblers were released from manual labor. The introduction of assembly robots has made it possible to convert from traditional assembly operations to individual comprehensively mechanized sections equipped with robotized assembly units. The work of unit troubleshooters has more content now and is more interesting and less fatiguing. Labor productivity in assembly has increased 5 - 8 fold. In 1982 the plant collective was awarded the AUCCTU's Diploma and bonuses for mechanizing and automating manual and heavy labor.

Planned work is being conducted to reduce manual labor at the following production associations: the Vesoizmeritel' in Armavir, the Mikropribor and imeni 60 Years of the Soviet Ukraine in L'vov; at the following watch plants -- the Yantar' the 60 Years of the USSR and the First imeni S. M. Kirov in Orel, at the Second Moscow and the Minsk, at the Leningrad Electromechanical Plant and at other enterprises.

The trade union Central Committee is exercising various forms of control over the work conducted in this direction by trade union committees and economic managers at associations and enterprises in machine and instrument building sectors. It is discussed at meetings of the trade union Central Committee Presidium and Secretariat. In examining sector standards, technical conditions and targets, special attention is directed towards equipping machine tools and machinery with automation and mechanization devices (blank and part supply).

Thus, at the initiative of the union Central Committee, the Minstankprom [Ministry of the Machine Tool and Tool Building Industry] has developed and coordinated with the Central Committee standard recommendations on the modernization of casting and forge-press equipment that is in operation but which is no longer being produced. Recommendations on the modernization of metalcutting equipment are in the agreement stage.

In 1982 the trade union Central Committee conducted a selective review of the manufacturing part of plans for the construction of new and the reconstruction of existing production facilities to reduce the share of manual labor. During the expert review specific suggestions were made on reducing the level of manual labor and on including additional means of mechanization and automation. This work will be continued in 1983.

There have been considerable improvements in the organization of work to reduce manual labor after the ACCTU's targeted comprehensive program of trade union participation in work to reduce manual labor in sectors of the national economy during 1982-1985 and up to 1990.

Ministry orders have determined the units responsible for coordinating work on production process mechanization and automation. At Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems] these duties are entrusted to the VO Soyuztekhnopribor, at Minlegpishchemash [Ministry of Machine Building for Light and Food Industry and Household Appliances] to the VPO Soyuzorgtekhavtomatizatsiya and at Minstankoprom to the NPO Orgstankinprom. At the suggestion of the trade union Central Committee, commissions have been created in these ministries to supervise the development and realization of targeted programs for the reduction of manual labor. These are headed by deputy ministers and their staffs include responsible workers from the trade union Central Committee. Similar commissions were formed at each subsector. At each sector main institutes have been delineated to implement a unified technical policy on these problems.

Upon agreement with the trade union Central Committee, ministries have worked up lists of machinery and equipment subject to removal from production, working at which involves monotonous and dangerous labor and where conditions are difficult and harmful to human health. Sectorial lists have been made of jobs which use

manual labor and which will be the first to be mechanized. The number of workers engaged in manual labor has been determined for each of these professions.

It is important to stress that it is intended to reduce manual labor through the introduction of progressive technology and automatic manipulators with program control (industrial robots).

Thus, during the 11th Five-Year Plan Minstankoprom is to organize the large scale production of various types of robots, including those for servicing metal cutting machine tools, forge-press and foundry equipment. Minpribor has developed a targeted comprehensive program for the creation and introduction of robots, manipulators and robot-technical complexes. A similar program is under way at Minlegpishchemash.

A large share of loading-unlaoding, warehouse and transport work is still done manually. The mechanization level of this work is increasing from year to year, but at an insufficiently rapid pace.

The approach to this problem at Minlegpishchemash deserves attention. At the ministry's behest, the Crimean Planning-Design Technological Institute has worked out standard solutions to increasing the organizational-technical level of loading-unloading, warehouse and transport work. These were approved by VPO Soyuzorgtekhavtomatizatsiya and have been sent to all enterprises in the sector. They have been given a list of 116 types of equipment for mechanization, their technical characteristics and the types of work where they might be used, approximate costs, names of the manufacturing or developing plant and a series of plans. Fifteen plants in the sector are entrusted with the manufacture of this equipment for small-scale mechanization.

At the same time there are still shortcomings and unutilized potentials in the work to reduce manual labor. USSR Gosplan's targets for its reductions are not always met, especially during the first years of the five-year plan, entailing the necessity of making up losses in subsequent years, something not easy to do. Therefore managers and trade union committees at associations and enterprises should now determine their potentials for solving this problem and actively utilize them. This will make it possible to improve working conditions and standards of production and to increase labor productivity. The scientific-technical public -- the primary organizations and administrations of NTO and VOIR -- should make their contribution to solving the problem of manual work mechanization and automation. Wider use should be made of inspections and contests, schools of progressive experience and seminars. The Central Administration of NTO Mashprom and Priborprom, scientific-technical councils of ministries, sector journals and sector institutes for scientific-technical information should also not stand on the sidelines in the solution of such a major economic and social problem as the reduction of manual labor.

Trade union committees at associations and enterprises must more widely use the principles of moral and material incentives for the introduction of new technology. Indicators for the implementation of measures to reduce manual labor should be among the basic ones taken into consideration in summing up results of socialist competition between enterprises, shops and sections. Problems in

the reduction of manual labor must be reflected in collective contracts and plans for the economic and social development of labor collectives. Well planned, goal directed and specific work plus initiative and a feeling of high responsibility on the part of each worker and manager will all make possible the fulfillment and overfulfillment of targets for the reduction of manual labor. This in its turn will help each enterprise and the machine building sectors in general reach the five-year plan's targets.

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CSO: 1823/21

PROBLEMS RELATED TO ASSIMILATION OF NEW TECHNOLOGY VIEWED

Moscow FINANSY SSSR in Russian No 5, May 83 pp 25-27

[Article by M. A. Lupachev, candidate of economic sciences,senior associate at the NIFI (Scientific Research Institute of Finance): "Improving Conditions for Producing New Equipment"]

[Text] A special place is given in the system of new equipment measures to its mastering and release. A decisive role is played by machinebuilding, on which the retooling of all branches of the national economy depends. "The development of science is the ultimate foundation of scientific-technical progress," the 26th CPSU Congress noted, "but it is foremost machinebuilding which opens wide the door to innovations. Machinebuilding is called upon to master without delay advancements developed by scientific and engineering thought and to embody them in highly effective, reliable machinery, devices and technological lines.[1] At the same time, it should be noted that the release of new machinebuilding output is one of the most complex lines of technical progress.

During the 9th and 10th five-year plans, the production of new machinebuilding output was increased substantially. In the 8th Five-Year Plan, we began series production of 1,400 new pieces of equipment; in the 9th -- 2,600, and in the 10th -- 2,700. Obsolete types of equipment were simultaneously being withdrawn from production intensively.

In spite of the broad scope of machinebuilding output updating, the proportion of newly mastered items in total production volume remains small. During the last decade, it has even decreased somewhat. In the 9th Five-Year Plan, the proportion of output in its first year of production averaged 6.6 percent per year for machinebuilding as a whole, and in the 10th it dropped to 6.2 percent.

The slower growth in expenditures for these purposes had a definite negative influence on this. In the 9th and 10th five-year plans, expenditures on mastering new machinebuilding output increased considerably slower than expenditures on other new equipment development directions. This was connected with their comparatively low effectiveness. For the data, see Table 1 [following page].

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[1] "Materialy XXVI s"yezda KPSS" [Materials of the 26th CPSU Congress], Moscow, Izd-vo Politizdat, 1981, p 44.

Table 1. Additional Profit Per Rubles of New Equipment Expenditures, Machinebuilding as a Whole (in comparable form, kopecks)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
machinebuilding as a whole	48.1	47.2	40.3	50.1	40.1	31.4	32.2	29.5	32.4	32.7
mastering new types of output	28.1	23.3	19.7	27.4	17.9	11.0	11.4	16.4	11.1	11.6

The mastering of new types of output has always been complicated in general for any enterprise. Expenditures per ruble of commodity output have generally been higher for new types of output than branch averages and have worsened cost-accounting activity indicators. This has, in turn, lowered the interest of machinebuilding enterprises in updating output. For confirmation of this, see the data in Table 2.

Table 2. Change in Expenditures Per Ruble of Commodity Machinebuilding Output

(kopecks)

	1977	1978	1979	1980
average branch expenditures per ruble of output:				
all commodity output	82.12	81.42	82.47	82.56
newly mastered output	83.44	83.86	84.24	84.42

The fastest possible reduction in higher outlays on the production of new types of output is an important stage in their mastering. Aggregate outlays on the production of new equipment evolve from expenditures on developing a technical innovation (scientific research and experimental design), creating and testing a prototype, and mastering series production of the item. Clearly, expenditures yield an impact if the work is done precisely at each stage.

Unfortunately, the materials of checks made by finance agencies of scientific research, planning-design and technological organizations and enterprises show that there are a number of shortcomings retarding the mastering of technical innovations.

Quite often, numerous changes are made in the topic plans for creating, mastering and introducing new output, which naturally increases the time involved in introducing scientific-technical developments into production; individual projects thus lose their immediacy and the expenditures on them turn out to have been wasted. Of the 16 enterprises and organizations of the Ministry of Machine Tool Manufacturing and Tool Industry which were surveyed in 1979, twelve had repeatedly changed their new equipment plans (70 percent). These plans often anticipate unnecessarily lengthy schedules for doing the work. For example, the special machinebuilding design bureau of the Leningrad Machine Tool Association imeni Ya. M. Sverdlov finished in 1979 a planned six years of development, manufacture and prototype bench-testing of welded machine tool parts at an estimated cost of 100,000 rubles and an economic impact of 200,000 rubles.

Scientific-technological developments are sometimes not introduced into production for a long time, delaying receipt by the national economy of an economic impact from their introduction and leading to obsolescence of new machinery and equipment designs. In 1976-1978, the Ulyanovsk lead specialized design bureau for heavy-duty milling machines worked out technical plans for the UF0784, UF-0786, UF0787 and 653MFZ-3 models, at an overall estimated cost of 188,500 rubles. These machines have yet to be introduced into production. At the same time, the economic impact of these developments was planned to have been 2,083,500 rubles. Also unintroduced are developments under 10 projects costing 286,500 rubles completed by the All-Union Scientific and Planning-Design Institute of Reductor Building during 1975-1977. The anticipated economic impact was 1,877,500 rubles. The situation is similar at the Ukrainian Scientific Research Institute of Tools and Machine Tools. Back in 1967, it began developing standardized optical platforms. A prototype was manufactured in 1974, but series production was begun five years later. Work done by the institute in 1979 on developing automated machine-tool manufacturing plant sectors using preset-control machine tools, work costing an estimated 198,000 rubles and with an expected impact of 400,000 rubles, is proposed for introduction into production in...1983.

Considerable funds are spent on scientific-research developments which are, for various reasons, stopped before completion. And the expenditures on stopped scientific research and experimental design which are written off have been growing year by year. Actual expenditures on developing and introducing new equipment often exceed estimated costs; work and expenditures are often duplicated and exceed their future return.

And so the funds directed into developing new machinery and equipment are being used insufficiently effectively. One of the main reasons, we feel, is the uncoordinated actions of scientific research, planning-design and technological organizations and the enterprises producing new equipment. This lack of coordination is already evident in the planning of new equipment, where schedules differ in the plans of developers and producers. We need to improve the methods of planning called upon to direct all activity involved in developing new equipment towards end results. The target-program method seems most suitable. The program must be designed with consideration of all factors influencing the mastering of technical innovations. It must state the specific implementers of each section, those bearing full responsibility for its implementation. Such an approach permits concentrating the efforts of specialists on the decisive work stages and a faster reduction in outlays on mastering the production of new equipment.

The concentrating of material, labor and financial resources is one of the main directions in which to accelerate output updating and lower the net cost of the models being mastered. This problem has not yet been solved. Funds being directed into releasing new output are sometimes scattered. Machinebuilding enterprises therefore often fail to cope with plan assignments for releasing new machinery and equipment, which naturally impacts on the development of other branches of the national economy.

The successful actualization of scientific-technical developments is possible only given their introduction on a broad scale. However, increasing the release

of new output with higher expenditures worsens cost-accounting indicators of enterprise activity, which in turn becomes an obstacle to its expanded production. We need effective steps to reduce as quickly as possible the net cost of new items, but it is hard to achieve this when resources are scattered. The whole process of creating new equipment models, from development to actualization, must be fully provided with all types of resources. In planning expenditures for these purposes, we need to distribute funds in amounts facilitating the fastest possible mastering of new output and lowering outlays on its production.

Perfecting the financial-economic mechanism and the fuller use of financial levers and incentives play a major role in mastering the release of new output.

Among the most important incentives is compensation for the higher expenditures involved in mastering new output. Many proposals are now being made concerning perfecting the compensation mechanism, which is called upon to create conditions favorable to the management of enterprises mastering new types of machinebuilding output. In recent years, the Unified Science and Technology Development Fund (YeFRNT) has been widely used to finance scientific research, experimental design and technological work, to reimburse expenditures on the development and mastering of new output. It was first created in 1969 in the Ministry of Electrical Equipment Industry, when the branch was changed over to a new system of planning and economic incentives for new equipment work.

At present, the YeFRNT is generated through two sources, in accordance with the "Instructions on Procedures for Planning, Financing and Recording Expenditures Made Through the YeFRNT," which were approved on 22 October 1980 by the State Committee for Science and Technology, the Gosplan, Ministry of Finance and USSR Central Statistical Administration: planned profit from ministry production-economic activity and a portion of the additional profit from the marketing of highly effective new output and that with the state Badge of Quality. This procedure has heightened enterprise interest in the broad release of high-quality items and in updating their assortment.

The YeFRNT performs a double role. A portion of its funds finances scientific research and another portion goes to reimburse expenditures on mastering products and improving product quality. It is very important that funds from this portion be properly distributed. The YeFRNT must cover the higher expenditures on new output in the first year of series production. However, we do not always succeed in doing this in practice: the amount of funds allocated for mastering the production of technical innovations does not permit reimbursement of the manufacturing enterprise for its higher expenses. Many enterprises planning to master the release of new equipment receive from superior organizations severalfold less YeFRNT funds than they actually require, and some receive nothing at all from this fund, although they are participating in the development of new equipment. As a result, expenditures on mastering the production of new output are written off to net cost. All this lowers the incentive influence of the YeFRNT.

From a national economic point of view, mastering expenditures begin with scientific research on and the development of the principles of new technology and new types of output. Expenditures on science, one of the primary elements in

mastering expenditures, are reimbursed from the budget and the funds of the enterprises, associations and ministries themselves, from funds received by scientific organizations under contracts with clients. These expenditures sharply exceed the level of funds for introducing new equipment (Table 3).

Table 3. Expenditures on Developing Science and Introducing New Equipment

	(in billion rubles)	
	9th FYP	10th FYP
expenditures on science, from all sources of financing (yearly average)	15.4	19.4
expenditures on introducing new equipment (yearly average)	6.2	8.7
including expenditures on mastering new output	0.73	1.02

Thus, average annual expenditures on science are more than two-fold higher than expenditures on introducing new equipment and are 19-fold higher than expenditures on mastering new output. A disproportion arises between the rapid growth in scientific developments and their slow mastering in production.

Today, we have a large stockpile of highly effective scientific and planning-design developments. An increase in the amount of funds being directed into their industrial utilization is necessary for their fastest possible actualization. In this connection, it seems appropriate to redistribute YeFRNT funds slightly in favor of that portion used to reimburse expenditures on mastering the production of new equipment.

The mastering of new equipment is also being delayed by the incomplete financing of enterprises producing it. The YeFRNT is concentrated at lead enterprises mastering the production of new items under new-equipment plans. However, dozens and sometimes hundreds of suppliers and manufacturers of assembly components, subassemblies and materials are also participating in this production on a cooperative basis. In many instances, there are no coordination plans uniting the efforts of all enterprises. YeFRNT funds are generally not allocated to enterprises supplying assembly components or to the various subordinate ministries. Without financial sources to reimburse the additional outlays, these enterprises either do not set up the release of finished products at all or schedule their production over extremely long periods. YeFRNT financing must be comprehensive. To this end, coordination plans uniting the efforts of all the participating enterprises must be worked out for all the most important types of new equipment. One section of these plans should be a comprehensive plan for financing the mastering of new equipment.

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OPERATIONAL EVALUATION IN MACHINEBUILDING SECTOR DISCUSSED

Kiev EKONOMIKA SOVETSKOY URAINY in Russian No 5, May 83 pp 57-62

[Article by A. Yelfimov, candidate of economic sciences: "On Methods for Norm Calculation of Production Capacity Utilization"]

[Text] Along with other measures for raising the efficiency of production, specified by the decree of the CPSU Central Committee and the USSR Council of Ministers on improving the economic mechanism, the use of norms for utilizing production capacities will occupy an important place. This will stimulate enterprises to identify intraproduction reserves for increasing the output from every point of view and will provide the possibility of planned regulation of the level of utilization of the available production potential and the necessary volumes of capital investments for its expansion. Capacity as an economic category is the production potential of an enterprise or sector. However, it is important for the planning organs to know not only the potentials of production, but also how they will be utilized, i.e., how many products can (must) be obtained by the national economy from the available production potential. The problem of norm utilization of production capacities is exactly in establishing the quantitative relationship (measure of blending) between the actual level of production and the potentials of an enterprise or sector.

The planning coefficient of production capacity utilization presently used in practice is of a calculated nature. It is determined after the average annual capacity and production program (output) are calculated. Unlike it, the norm of production capacity utilization, in its functional purpose, is a departure point (initial) in the determination of plan targets according to the volumes of production.

The development of a new norm indicator requires considerable investigations of an entire set of questions. The most important one is the selection of the method for calculating the utilization of production capacities. The use of the method for calculating the norm of the utilization of production capacities based on the so-called "annual planned capacity," proposed by B. Voskresenskiy and V. Kotlov, involves considerable difficulties.* This method does not contain a clear mathematical calculation formula; it does not

* See: Selection of a norm for utilizing production capacities in industry. PLANOVOYE KHOZYAYSTVO No 2, 1981.

take into account the relationship between the norm calculation and the product output, which is the only measure of the utilization level of production capacities; it does not specify ways to solve the problem of informational provision for the proposed method.

The economic content of the norm for utilizing the production capacities predetermines its calculation (measurement) in relative values. The very name of the norm speaks about that: it assumes the establishment of measures and degrees of realizing that which has an absolute expression. Moreover, only with a relative calculation of the norm is it possible to establish an equal degree of utilization of the potential capacities of enterprises and sectors of industry that have capacities which are different in magnitude and purpose. It is also necessary to take into account the high mobility of the magnitude of capacity, that changes constantly by the action of various factors and conditions and complicates the calculation of the considered norm in absolute expression. Therefore, the norm for the utilization of production capacities N_m must represent a ratio whose numerator is a practically achievable, so-called rated product output (O_r) of an enterprise (subsector), while the denominator is the current average annual capacity (M_d) of the enterprise (subsector).

The first necessary condition for the correct determination of the considered norm is the validity of the magnitude of the capacity itself. The magnitude of the capacity determined by the enterprises themselves in most cases does not reflect its real magnitude. The objective circumstance for this is the extreme complexity and mobility of the various factors that affect the magnitude of the capacity. However, the desire of enterprise managers to have hidden capacity reserves is of decisive importance. It is possible to avoid this only by strict observance of the regulations and requirements of the "Interindustrial instruction for determining production capacities" and the clarification of its individual regulations. First of all, it is necessary to eliminate from the practice of calculating capacities the too free interpretation of the concept of the "leading" group of equipment whose production potential determines the capacity of the shop and the machinebuilding plant as a whole. For this, it is necessary to develop and confirm a typical composition of equipment groups, included in the calculation of production capacity, define clearly what leading equipment means, and establish a strict order of referring to equipment as leading.

At present, each plant groups equipment in its own way. Thus, at the "Kievpolimermash" PO [Production Association] metal-cutting machines are divided into 37 groups; at the single-type Kostroma Plant imeni Krasin -- into 17 groups; and at other polymer machinebuilding plants -- each has composed its own group. At the "Kievpolimermash" PO turning-threading machine tools with the center height (VTs) of only 200 to 299mm were taken as the leading group in 1982 in capacity calculations; at the Kostroma Plant -- all turning-threading machine tools (up to 200mm, 201 to 250mm, 251 to 300mm, 301 to 400mm, 401 to 500mm and greater). Such lack of coordination is not accidental. Frequently, it is used artifically to reduce the potential possibilities of the enterprise. As may be seen from the calculation data of the capacities of the "Soyuzpolimermash " VPO [All-Union Production Association],

production potential of leading groups of equipment, assumed by this association as a basis for calculating its capacity is, as a rule, the lowest as compared to the production potential of the remaining groups of equipment. As a result, the capacities of plants, in spite of the requirements of the interindustrial instruction is frequently determined by the bottleneck "link" and not by the "leading" link. An analysis shows that only by the correct selection of the leading group equipment can the rated capacity of the indicated plants be increased by not less than 5 to 10%. At the "Kievpolimermash" PO, for example, with strict observance of the requirements of the interindustrial instruction the production potential of the leading equipment groups should be higher by 12.2% than that assumed by the plant.

According to the interindustrial instruction, leading means that equipment, "which does the greatest volume of work according to the labor-intensiveness." Regrettably, this correct regulation has no clear-cut quantitative expression. As a result, plants assume as leading most different equipment. Thus, in the "Kievpolimermash" PO among leading in capacity calculations in 1982 were gear-cutting machine tools whose labor-intensiveness of work was slightly over 3%, but did not include groups of machine tools whose shares of the general labor-intensiveness of work was 10.2% (turning-threading machine tools with a VTs of 300 to 499mm), 9.1% (turret-head semiautomatic), 6.8% (vertical milling), etc. This situation exists also at other plants.

To eliminate the subjective approach and the possibility of artificial understatement of the potential ties of enterprises, it is necessary to regulate the share assigned to basic equipment groups in the total labor-intensiveness of work. Their share must be (depending upon the distinguishing features of the production) not less than 1/3 to 1/4 of the total labor-intensiveness of work and, first of all, the leading equipment must include those groups whose labor-intensiveness of work is the highest. Thus, the leading equipment group at the "Kievpolimermash" PO is practically all turning-threading machine tools (with VTs from 150 to 500mm) that are interchangeable to a certain extent, and that do the basic share (35.1%) of machining work of total labor-intensiveness (according to the 1982 data) should be included.

An understatement of the capacity leads unavoidably to the distortion of the quantitative value of the utilization norm of production capacity. This eliminates the possibility of a "straight linear" calculation of the considered norm. Under such conditions, a flexible system of means is required which, in its interaction, will make it possible to catch most fully the actual potential ties of utilizing production capacities. It includes the following: sector (basic) norm (N_m^b); centralized set task on raising the norm of production capacity utilization (Z_n^p); organizational-technical measures, whose realization is called upon to insure the achievement of the set task on raising the norm of production capacity utilization. Specific norms for utilization of production capacities for each enterprise (N_m^k) are formed according to the following formula:

$$N_m^k = N_m^b \times Z_n^p$$

Another more important initial component in forming this norm that requires the uncovering of the economic content and the substantiation of the right to exist, is the "rated output of products." Unlike a production capacity that reflects only the potential production capacity, the rated output of products is the volume of production that can and must be achieved under existing production conditions. It is determined on the basis of current existing technical, technological, organizational and other means, and not on assumed favorable production conditions, which take place in the determination of the value of the capacity. The quantitatively calculated output of products must be 100% achievable and take into account all production potentialities achievable at the present stage. On the other hand, unlike set planned tasks, in determining the rated output of products, shortcomings are not taken into account in organizing the production process, material-equipment procurement, lack of manpower, i.e., those things that depend on subjective production factors.

The technology of determining the rated output of products is similar to the order of calculating the values of production capacities. However, the method of taking into account each factor and, therefore, forming the quantitative parameters of this indicator is quite specific. According to the methodological rules for calculating the value of capacity, the disparity in the transit capacity of individual equipment groups should not be taken into account. "Bottlenecks" must be eliminated by carrying out various organizational-technical measures. Under current production conditions, this is not always fully possible even with intensive organizational-technical measures. Therefore, in determining the rated output of products, the effect of "bottlenecks" on the actual production potentialities should be taken into account. For this purpose, an average-weighted conjunction coefficient ($\bar{K}^{s}_{nps}$) is used.

$$\bar{K}^{s}_{nps} = \frac{PV_{nps} \times T_{nps}}{T_{nps}} : PV_{vgo}$$

where PV_{vgo} -- production potential of the leading equipment group, assumed in calculating the capacity; PV_{nps} -- production potential of individual equipment groups with the lowest transit capacity; T_{nps} -- labor intensiveness of individual equipment groups with the lowest transit capacity.

According to Table 1, it is possible to calculate the conjugation coefficient (0.92) and the actual obtainable production potential of the basic technological equipment, assumed as a basis for the rated output of products. The average weighted conjunction coefficient obtained by calculation may be made precise experimentally in the process of developing the base norm for utilizing capacities on the basis of studying the experience and evaluating the intraindustrial conditions of the technological conjunction of equipment. Taking this coefficient into account corrects the production means of the leading group of equipment for the purpose of obtaining an actually attainable production means (PV_{rd}), assumed as the initial base of the rated output of products. The correction is made according to the following formula:

$$PV_{rd} = PV_{vgo} \times \bar{K}^{s}_{nps}.$$

Table 1

Production potential and labor intensiveness of work on equipment groups assumed in calculating capacity (basic production in the "Kievpolimermash" in 1982).

Groups of Equipment	Production potential (ratio of actual fund of time to labor-intensiveness in %) (PV)	Labor-intensiveness of work (T)	
		Machine tool-hour	In % of labor-intensiveness of program
Equipment groups we referred to as "leading" according to instruction (turning-threading with VTs from 150 to 500 mm) (vgo) [leading group of equipment]	111.2	635,860	35.1
including turning-threading machine tools with VTs 200 to 299mm, assumed "leading" by the plant	99.0	320,388	17.1
Equipment groups with lowest (as compared to the "leading" link) possibility--total (nps) [lowest transit capacity]	102.3	395,065	15.6
including:			
-- turning-threading machine tools with VTs 200 to 299mm	99.0	320,388	17.1
-- turret semiautomatic automatic machines	109.0	164,453	9.1
-- jig-boring	104.0	15,388	0.9
-- upright-drilling	102.0	23,606	1.3
-- radial drilling with diameter to 80mm	102.0	90,498	5.0
-- diameter greater than 80mm	106.0	37,963	2.1
-- planer 1800 to 2000mm wide	101.0	10,713	0.6
-- gear-cutting diameter greater than 2000mm	99.0	52,449	3.1

The correctness of the method for calculating the weighted-average conjunction coefficient is determined by a number of circumstances. As shown by experimental calculations for the "Kievpolimermash" PO and the "Kievprodmash" Plant, the number of equipment groups with the lowest production potential is insignificant. Also, small is the gap between the production potential of leading equipment and equipment with the lowest transit capacity. Thus, in the "Kievpolimermash" it varies between 1 to 9% and in the "Kievprodmash" Plant -- from 3 to 18%. Especially important is the fact that the conjunction coefficient orients enterprises toward searching for additional reserves to raise the transit capacity of lagging equipment groups.

In the correct establishment of the production potential of the leading equipment group and, therefore, also in the substantiation for forming the value of the rated output of products, the composition of the equipment assumed in the calculation plays an important role. If the calculation of the production capacity includes all operating and nonoperating equipment (except those especially stipulated), then in determining the rated output of products the nonoperating equipment is disregarded in the calculation. Equipment in the process of installation and at a warehouse, before it is put in operation, is also not used in the calculation. Specific requirements on equipment composition, included in the calculation, are set by industrial institutes on the basis of an analysis and correlation of experience, as well as by taking into account the distinguishing features of the enterprises of the given subsector of the industry (the type of production or the enterprise).

In calculating the production capacity, an output achieved by 20 to 25% of machine tool operators is assumed, i.e., of a comparatively small, leading part of the workers, which determines the capacity as a potential possibility. Based on the economic content of the indicator for the rated output of products, the value of the latter is determined on the basis of the output of the basic mass of workers. In our opinion, the share of the basic part of the workers should be no less than 75 to 80% of their total number. This bases the determination of the rated output of products not only on the potential of the majority, but also eliminates from the calculation that part of the machine tool workers which has the least productivity.

The determination of the rated output of products is also based on the time fund actually used. For its determination, it is proposed to use data of the one-time record of technological equipment idle time made by the USSR TsSU [Central Statistical Administration] every two years. The data of this investigation in the "Soyuzpolimermash" VPO indicates that the idle time of metal-working equipment is considerable and remains constant from year to year. The indicated fact shows that at the modern level of organization of production, it is impossible to eliminate fully many kinds of time losses. This is also indicated by plant data of operational idle time of equipment. The composition of causes for idle time is shown in Table 2.

Table 2

Composition and structure of idle time of technological equipment according to types and causes in the "Soyuzpolimermash" VPO (basic production time behavior)

	Total idle time of equipment (machine tool-hours)	Structure of equipment idle time for reasons (in % of total)					
		Surplus equipment	Failures, unplanned repairs	Breakdown, resetting	Lack of manpower	Lack of task	Lack of material intermediate product parts
"Soyuzpolimash" VPO, total	33,915	1.3	9.1	1.1	42.7	4.6	6.7
including metal-cutting machine tools	25,007	1.0	8.4	1.1	51.1	4.1	5.5
"Kievpolimermash" PO, total	9,654	0.2	7.5	0.7	36.3	0.2	0.9
including metal-cutting machine tools	7,073	0.2	6.0	0.3	47.2	0.3	1.0
"Dnepropolimermash" total	2,842	1.7	9.2	0.7	75.6	4.3	1.2
including metal-cutting machine tools	2,430	2.0	9.4	0.4	77.0	2.9	1.1

Table 2 (continued)

	Lack of tools, fixtures, lifting-transporting facilities	Absence of workers with permission of management	Absenteeism, and violation of labor discipline	Planned repairs, modernization, reserve, mothballed	Other idle times
"Soyuzpolimermash" VPO, total	1.5	10.0	0.2	11.0	11.7
including metal-cutting machine tools	1.3	9.8	0.2	9.1	8.5
"Kievpolimermash" PO, total	0.5	14.9	0.03	17.2	21.6
including metal-cutting machine tools	0.4	13.6	0.04	17.9	13.0
"Dnepropolimermash," total	1.3	2.8	-	3.1	0.1
including metal-cutting machine tools	0.9	3.3	-	3.0	-

An analysis of the one-time investigation data by the USSR TsSU on the operational records of the "Soyuzpolimermash" VPO plants makes it possible to conclude that a certain part of these losses is unavoidable with the existing production standard. This unavoidable part of time losses (NP_t) is not included in the fund of time of equipment operation, assumed for the basis of determining the rated output products. The actual fund of time (RF_t) is the difference between the nominal fund (NF_t)* and the unavoidable part of the total time losses.

* The "nominal" time fund means the time behavior fund after deducting the norm time for repairs and other technological needs.

Time losses due to lack of production tasks; raw and other materials; intermediate products, components; tools, fixtures, lifting-transporting facilities; technical documentation; absenteeism, violation of labor discipline, should not be taken into account in determining the rated time fund, because they depend entirely on the perfection of planning and organization of production, the initiative and the enterprise of the enterprise administration and the state of labor discipline.

The quantitative evaluation of the unavoidable losses for each kind of production (subsector) with their production-technical distinguishing features, and special working conditions is made by the corresponding industrial NII [Scientific-Research Institute] on the basis of the average-industrial statistical data on idle times of various kinds of equipment, on the basis of operational accounting data on time losses, and a thorough analysis and study of the operating practices of the enterprises in the sector.

The rated output of products is determined once in five years during the formation of the sector (basic) norm for utilizing production capacities. The latter is developed for each subsector of the industry or type of production.

The basic norm for the utilization of production capacities accumulates actual production conditions and achievements of all enterprises in the subsector, while only one norm is set for enterprises included in the given subsector (type of production). However, in itself, the basic norm cannot solve the problems and fulfill the functions placed on the norms for utilizing production capacities by the decree of CPSU Central Committee and the USSR Council of Ministers on improving the economic mechanism. In its content and purpose, the base norm of the industrial sector is the basis for calculating specific plan norms for utilizing production capacities for each enterprise (N_m^k). The norms are used by enterprises to prepare planned tasks for utilizing production capacities.

With the proposed method for forming the norm for utilizing production capacities, the practical work of enterprises, sector administrations, ministries and departments on improving the utilization of production capacities will be concentrated on developing a plan of organizational-technical measures. Their preparation will be carried out taking into account the specific conditions and resources of each enterprise, and must be directed to the maximum utilization of all intraproduction reserves. This will make it possible, first, to fill in those blanks which will unavoidably be allowed in calculating the capacity and, therefore, in the norm of their utilization and, secondly, formulate individual tasks on identifying reserves and norms for the utilization of the production capacity of each enterprise.

An important advantage of the proposed method for forming norms of production capacity utilization is the extent of the provision for information. All necessary initial data for norm application in the practice of planning is available. They are contained in data on calculating production capacities presented by enterprises to higher ranking organizations, in statistical

data of one-time investigations, in the operational records and planning. Later on, it is only necessary to introduce some clarifications in criteria used in the one-time investigation done by the USSR TsSU, in order, that on the one hand, some kinds of equipment idle time (absence of workers by permission of the administration, due to sickness, etc.), be separated as independent and, on the other hand, have data with respect to the leading group of equipment for all observation indicators.

2291
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STATISTICAL DATA ON USSR MACHINEBUILDING INDUSTRY

Moscow VESTNIK STATISTIKI in Russian No 4, Apr 83 pp 68-70

[Statistical Tables]

[Text] II. Main Indicators of the Use of Productive (Metalworking) Equipment at Machine Building Enterprises of Machine Building Ministries, From Observation Data on 19 May 1982

1. Use of Productive (Metalworking) Equipment at Machine Building Enterprises of Machine Building Ministries

Item	Nonworking equipment as percent of installed equipment	Shift coefficient of equipment operation	Intrashift idle time as percent of machine tool shift time worked	Machine tool hours worked per unit of installed equipment per day
All metal working equipment	14.7	1.33		
Including				
Main production	14.1	1.41	10.7	9.9
Auxiliary production	15.9	1.16		
I. Metalcutting machine tools -- all, including	14.5	1.32		
Main production	14.0	1.39	10.3	9.9
Auxiliary production	15.6	1.17		
NC machine tools in main production	15.3	1.41	8.9	10.2
Automatic lines for mechanical working	8.9	1.71	9.2	12.2

[Table 1. Continued]

Item	Metalworking equipment as percent of installed equipment	Shift coefficient of equipment operation	Intrashift idle time as percent of machine tool shift time worked	Machine tool hours worked per unit of installed equipment per day
II. All forge and press machines	14.8	1.40		
Including Main production	14.4	1.44	12.1	10.0
Auxiliary production	17.5	1.13		
Automatic lines for forging and forming operations	15.4	1.61	13.9	10.9
III. All casting equipment	14.6	1.65		
Including Main production	14.5	1.66	9.7	11.7
Auxiliary production	17.0	1.40		
IV. All electric welding machines	15.7	1.26		
Including Main production	14 7	1.34	10.5	9.5
Auxiliary production	18.0	1.07		

2. Reasons for Idle Time of Equipment in Main Production Operations (Percent)

Indicator	Metal-cutting machine tools	Forge-press machinery	Casting equipment	Electric Welding machinery
1. Amount of equipment not working at all during the day (entire day idle time)	100	100	100	100
Planned repair and modernization	15.1	18.6	26.5	17.5
Reserves and conservation	9.3	6.9	15.0	12.8
Excess equipment	3.9	2.7	2.2	3.1
Breakdowns and unplanned repair	10.9	14.0	15.8	12.1
Lack of production assignments	9.3	11.4	7.3	12.0
Shortage of workers	26.3	23.1	16.1	21.0
Absence of workers (with administration's permission; due to illness, etc.)	6.7	4.9	3.4	5.2
Absenteeism	0.2	0.1	0.1	0.2
Shortage of raw and other materials, blanks, parts, components	9.1	8.6	4.7	7.1
Shortage of tools, attachments, technical documentation, electrical and thermal energy, compressed air, lift and transport equipment	2.2	2.9	2.5	1.6
Shortage of program storage devices	0.2			
Other all-day idle time	6.8	6.8	6.4	7.4
II. Entire shift idle time (minus non-work condition time)	100	100	100	100
Planned repair and modernization	7.6	9.7	11.4	9.3
Breakdowns and unplanned repair	9.8	11.8	14.6	10.5
Lack of production assignments	11.9	13.0	12.9	14.5
Shortage of workers	39.5	35.5	29.9	34.2
Absence of workers (with administration's permission; due to illness, etc.)	8.5	7.0	6.5	6.8
Absenteeism	0.3	0.2	0.7	0.2
Shortage of tools, attachments, technical documentation, electrical and thermal energy, compressed air, lift and transport equipment	3.1	3.4	2.9	2.4
Shortage of raw and other materials, blanks, parts and components	9.1	8.7	7.9	9.0
Other entire shift idle time	10.2	10.7	13.2	13.1
III. Intrashift idle time	100	100	100	100
Breakdowns and unplanned repair	16.9	16.9	26.1	14.0
Equipment adjustment and set-up	18.5	22.7	15.6	13.5
Shortage of raw and other materials, blanks, parts and components	21.5	17.9	21.8	22.1
Shortage of tools, attachments, technical documentation, electrical and thermal energy, compressed air, lift and transport equipment	7.5	7.5	9.2	10.3

[Table 2 Cont]
[III. Intrashift idle time]

Indicator	Metal cutting machine tools	Forge-press machinery	Casting equipment	Electric Welding machinery
Lack of production assignments	9.7	11.3	6.8	12.2
Absence of workers (with administration's permission; due to illness, etc.)	6.6	5.9	5.0	5.6
Absence of workers due to violations of labor discipline	1.8	1.1	2.3	1.9
Other intrashift idle time	17.5	16.7	13.2	20.4

3. Use of Production (Metalworking) Equipment Engaged in Main Production Operations, by Ministry

Ministry	Nonworking equipment as percent of installed equipment	Shift coefficient of equipment operation	Intrashift idle time as percent of machine tool shift time worked	Machine tool hours worked per unit of installed equipment per day
For all ministries surveyed	14.1	1.41	10.7	9.9
Including				
Power Machine Building	16.3	1.38	6.8	10.3
Heavy and Transport Machine Building	17.0	1.32	10.9	9.3
Electrical Equipment	16.8	1.31	10.9	9.3
Chemical and Petroleum Machine Building	14.3	1.40	9.1	10.1
Machine Tool and Tool Building	15.5	1.32	8.7	9.6
Instrument Making, Automation Equipment and Control Systems	11.0	1.45	9.7	10.5
Automotive Industry	14.6	1.51	12.4	10.2
Tractor and Agricultural Machine Building	13.6	1.55	12.5	10.6
Machine Building for Animal Husbandry and Feed Production	14.8	1.47	12.1	10.2
Construction, Road and Municipal Machine Building	14.9	1.34	10.8	9.5
Machine Building for Light and Food Industry and Household Appliances	13.9	1.34	9.4	9.7

4. Use of Production (Metalworking) Equipment Engaged in Main Production Operations, by Union Republic

Republic	Nonworking equipment as percent of installed equipment	Shift coefficient of equipment operation	Intrashift idle time as percent tool shift time worked	Machine tool hours worked per unit of installed equipment per day
For all enterprises surveyed	14.1	1.41	10.7	9.9
Including				
RSFSR	14.6	1.39	10.9	9.8
Ukrainian SSR	13.2	1.45	10.1	10.3
Belorussian SSR	12.0	1.54	10.2	10.9
Uzbek SSR	14.4	1.37	9.1	9.8
Kazakh SSR	17.4	1.34	11.9	9.3
Georgian SSR	12.3	1.28	10.8	9.0
Azerbaijan SSR	10.0	1.43	9.0	10.2
Lithuanian SSR	10.7	1.52	11.5	10.8
Moldavian SSR	14.8	1.41	11.9	9.9
Latvian SSR	11.2	1.43	14.4	9.9
Kirghiz SSR	11.0	1.52	8.7	10.9
Tajik SSR	19.1	1.29	10.7	9.1
Armenian SSR	9.8	1.37	8.2	9.9
Turkmen SSR	32.6	0.82	9.1	5.9
Estonian SSR	16.6	1.18	11.8	8.3

11,574
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ORENBURG PLANT ACQUIRES NC MACHINES, MUST REORGANIZE

Moscow EKONOMICHESKAYA GAZETA in Russian No 36, Sep 83 p 6

[Article by V. Nikitin, assistant editor: "Orenburg 'Gidropress' Has Overcome Delays"]

[Text] Nikolay Fokeevich Antonov, an experienced lathe operator, recently stopped the general manager of the Orenburg Gidropress Association and requested a transfer to the PNC machine tool department.

How was the experienced worker to be answered? After all, it was not long ago that the general manager himself suggested that Antonov transfer to the PNC machine tool department. At that time Antonov refused: "No, I'll stay with my old machine," he nodded toward his well-worn lathe, "I have always made good wages here, while in the new department one never knows for sure."

It's true, in the department with equipment packed full of electronics there actually was some uncertainty at that time. Most of the newly installed machine tools were inoperative.

Today the Orenburg Gidropress Association workers don't like to think about why this fate had overtaken the new machines. However we can't understand the changes that have taken place without recalling these problems.

Only later did the obvious truth become clear at Gidropress: thought must be given to effective utilization of the new equipment before placing the order and and not at the moment of arrival of the equipment. And the personnel must be trained in advance.

The errors and mistakes that were made caused interruptions in production. In 1982 the Association was behind schedule in the production of dozens of difference presses with an overall cost of 287,000 rubles.

Lessons were learned from the schedule problems. Two production lines utilizing 23 PNC machine tools were assembled in the lead plant.

In addition the plant has adopted one of the elements of flexible technology in order to accelerate markedly the reconfiguring of the equipment. Hollow iron plates were placed under the machine tools in place of the heavy

foundations. The use of these plates made it possible to shorten by a factor of 2-3 the time required for assembly and disassembly of the machine tools in the future, when reconfiguring of the equipment is required.

Casting production remained a bottleneck until the adoption of highly-fluid casting mixtures. We could discuss the other measures as well. But it is more important to clarify another question: who initiated all these innovations?

The first step was more rational assignment of the personnel. In the Party organization there were some discussions: does it make any sense to keep on reprimanding the managers of the departments that are delaying the improvement of production? Can these departments be reorganized?

Some of the leading specialists were given different assignments in the Association. The transfers were carried out in a way so that the personal dignity of the generally conscientious workers was not affected. Their places were taken by more energetic engineers with a broad viewpoint, ready to undertake rational technical risks.

One of these was V. Bulgakov, chief production engineer of the lead plant. The main burden associated with production modernization fell on his shoulders. Another supporter of technical progress was A. Kiselev, deputy chief engineer. The use of the hollow metal plates for mounting the machine tools was his idea. His assistant V. Loshmanov contributed greatly in the re-equipping of the "first" shop.

The problem of developing the interest of the machine tool operators was more complex, particularly after the PNC equipment was so severely compromised because of the tactical errors of the engineering department. The burden of old habits, naturally, also had an influence.

However there were many workers who responded willingly to the new tasks. One of them was Aleksandr Ivanovich Vorobtsev, who created the first integrated brigade of young workers. After thoroughly mastering the PNC machines, he helped his subordinates to do the same. This work went well and several similar brigades soon appeared in the plant. They were headed by Vladimir Nikolayevich Izmalkov and Petr Aleksandrovich Shabanov.

Today 70 percent of the personnel in the primary shops in the main plant are working in integrated brigades. But the numbers of workers involved is not the only criterion.

The integrated brigades have been called on to prepare the drafts of the annual plans for 1984. The preliminary outlines are being transmitted to the shops. Participation of the large group of active workers in the discussion of the plans will make it possible to change over to competition on the basis of alternate plans.

Utilization of the reserve production capacity made it possible for the Association to make up for the previous production lag and then produce 67

presses in addition to the target established by the Five Year Plan. The contractual obligations relating to product deliveries are being met on schedule.

In the first seven months the labor productivity increased by 8.7 percent in comparison with the same period last year (the target was a 6.8 percent increase). Production of automatic presses and automated machining complexes has been initiated. And the machines of the future with remote control are being planned in the design office.

9576
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METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

TBILISI MACHINE TOOL PLANT PLANS PRODUCTION OF NEW-GENERATION LATHES

Moscow EKONOMICHESKAYA GAZETA in Russian No 35, Aug 83 p 8

[Article by Guram Shalvovich Dzhikidze, general manager of the Tbilisi Machine Tool Plant: "Retooling On the Go"]

> [Text] The trademark of the Tbilisi Machine Tool Production Association appears on heavy-duty lathes. For the workers of this plant the 11th Five Year Plan is a period of complete renewal of production and transition to the production of new machines and automated transfer lines. Guram Shalvovich Dzhikidze, general manager of the association [photo omitted], talks about the current activities of the Georgian machine tool makers. Educated as a mechanical engineer, Dzhikidze worked for 15 years at the Tbilisi Aircraft Plant imeni G. Dimitrov and advanced from foreman to deputy manager. Five years ago Dzhikidze became the head of the Tbilisi Machine Tool Production Association.

I usually start my working day with a visit to those shops where the situation may be difficult and may require personal familiarization with the current production situation and the making of prompt on-the-spot decisions.

Recently I have been visiting the "third" shop more often than the others. It is here that our new series-production lathe is being assembled. The machine is complex and not at all similar to the previous model. The assembly line has just been put into operation and there are still problems. So we seek solutions to the difficulties together with the team leaders, engineers and technicians.

Assembly line personnel are an inquisitive breed. It is interesting and useful to chat with S. Gomartel, S. Rodionov and the other workers. They talk in detail about the problems that are being resolved, where and why things are being held up, and express their opinions and criticize the decisions made by the designers.

The conversation concerning the new hardware in this relaxed working atmosphere is of considerable help, suggests new solutions and stimulates creative thought.

The Perspectives

Radical restructuring of machine tool production is the primary concern of our team of workers. The prospects for development of the lead plant and the other enterprises forming part of the association--the grinding machine plants and the machine tool component plants--are associated with transition to a higher level of production.

At the June 1983 CPSU Central Committee Plenum Comrade Andropov said: "A unified scientific-technical policy is becoming of decisive importance today. We are facing tremendous work in the development of machines, mechanisms and technology, both for today and for tomorrow."

The most important role in improving machine tool design and in raising labor productivity in this activity is played by the machine tool construction industry. Our association has an obligation to make its contribution to this progress.

Realization of this task has been complicated by the fact that until recently the association was far behind schedule. In the middle 70s the association did not meet the plan with respect to several technical and economic indexes and did not meet its contractural obligations with respect to product deliveries. The technical level of the machine tools produced and the quality of their fabrication did not satisfy the customers. This resulted in a precarious financial situation and considerable personnel turnover.

Even today the Tbilisi machine tool makers have not entirely overcome the consequences of the previous production lag, although the problems have been corrected and the situation in the association enterprises has now improved considerably. Many shops have been rebuilt and a new facility has been put into operation. Many changes have been made in the organization of production and labor.

We recognized that we could not raise production effectiveness without introducing new and modern (not only in terms of the date of manufacture but also with regard to qualitative characteristics) machine tools. We were pointed in this direction by the CPSU Central Committee and USSR Council of Ministers directive on improving the technical level and the competitiveness of the metalworking, casting and woodworking equipment and tooling. This basic document influenced our association in a very direct way.

The proposals prepared by the plant team were well received and supported at the Ministry of the Machine Tool and Tool Building Industry. Specialists from the Experimental Scientific-Research Institute of Metal-Cutting Machine Tools (ENIMS, Moscow) and designers from the Tbilisi SKTB [Special Design and Technological Office] of Machine Tool Building were made part of our association and assigned to this work. In the first stage they developed the basic models of the new machine tools and determined the schedules for launching their production.

This program resulted in a whole series of measures directed toward improving the operation of our association in the 1981-1985 period, and also in a plan for development of the machine tool construction enterprises located in Armenia. This plan was adopted by both the industry ministry and the Georgian Communist Party Central Committee.

Implementation of this plan is closely associated with the continued improvement of the efficiency of the entire production process and consists of many inter-related elements. If neat workplaces are not maintained it is difficult to eliminate the factors causing wastage and defective parts. If the equipment is not repaired on schedule it will not be possible to achieve the required accuracy and high class of fabrication of the new machine tools.

I have mentioned two very simple examples of what we mean by production effectiveness. Production effectiveness in the association was far from satisfactory in the recent past.

What has been accomplished in the last 2 and 1/2 years? How far has the association team advanced along the path of technological progress?

First Half of the Five Year Plan

As they say, we have recorded some pluses and some minuses. In 1981 the models of pipe cutoff machines with an adaptive control were put into production. Then we undertook production of specialized programmed numerically controlled pipe threading machines. Thus, the first year of the Five Year Plan was fruitful for our team.

There was the risk of running into problems in the stage involving the introduction of new product models. In addition to putting them into production, it was necessary to continue to fabricate the machine tools of the previous types, contracts for the delivery of which had been signed with dozens of customers.

The past year showed that our team is capable of handling this task. The annual plan was exceeded, somewhat making up for the production lag in 1981.

It is gratifying that in 1982 we mastered the production of four models of pipe cutoff machines, fabricated, an automated plasma cutting production line, an experimental model of a programmed numerically controlled lathe and several other products.

It is obvious that all this did not happen overnight, and there are still problems. It is not always possible to meet the planned machine design and production schedules, sometimes the new machine tool does not look exactly like the designers and production engineers thought it would. There are rough spots and errors. But the association team never backs off from the problem and always finishes the job.

Major support is provided by the scientific-technical institutions, our contacts with which have become considerably stronger in recent years. In addition to the forementioned ENIMS and the machine tool construction SKTB,

praise is also due the Georgian Polytechnic Institute imeni V. I. Lenin, the Planning-Technological Scientific-Research Institute for Machine Tool Building, and the Scientific-Research Institute of Economics, Planning and Management of the National Economy attached to Gosplan Armenia.

Cooperation with these organizations led to the birth of several interesting ideas, and the practical implementation of these ideas will make it possible to better organize production, raise production effectiveness and reduce the labor content in the machine tools.

The Future

We should not overestimate the results achieved. After all, all the new products carrying the Tbilisi trademark are specialized machine tools, produced by the association in small quantities. However, the primary output of the team in the 11th Five Year Plan will be the series-produced model 1M63D turning and threading machine. It has been developed in our SKTB with account for the ENIMS recommendations.

The decision has been made to develop other models of modern machine tools on the basis of this series-produced machine. Work in this direction has already started: three machine tools with a more advanced control system have been fabricated by the association this year. And in the 12th Five-Year-Plan period we intend to initiate the production of turning-threading machines with inclined ways--new-generation machines with improved technical and economic characteristics.

Our objective is to produce machine tools which not only meet the high requirements of today but will also remain effective in the future. In the design of the machines we shall incorporate the characteristics corresponding to the "State Symbol of Quality" certification.

Both the public organizations and the association administration are keeping these questions in mind. While the fraction of machine tools with the Symbol of Quality last year amounted to 20 percent of the overall output, this fraction will increase to 24 percent this year.

This figure is obviously still too low, and serious efforts must be expended in this direction. We plan to submit a new series-produced machine tool for the Symbol of Quality certificate this year, and by the end of the Five Year Plan we hope to raise the fraction of output of the highest quality category to 56 percent.

The association team is attempting to reduce production costs. We are emphasizing zero-defect fabrication of all the parts and assemblies of the machines and are attempting to reduce intraplant wastage and minimize user complaints. Increasing the responsibility of the individual workers and strengthening labor discipline are of decisive importance. We have many deficiencies in this area. Over 2,500 man hours were lost last year because of absenteeism.

The directives adopted by the CPSU Central Committee, the USSR Council of Ministers and VTsSPS [All-Union Central Trade Union Council] relating to strengthening of socialist labor discipline gave new impetus to the labor activity of the machine tool builders and the fight against absenteeism and violators of the established procedures. We shall approach these individuals from various directions, combining the influence of the force of public opinion with direct disciplinary measures.

Brigade organization of labor will help to strengthen the work force. We have already formed 65 brigades and they include a third of all the workers. The collectives in which unified work scheduling is used are outstanding. Labor productivity is higher in these collectives and product quality is higher. By the end of this year we plan to have 45 percent of the workers on this more advanced form of labor organization and payment, and by the end of the Five Year Plan this index should be up to 70 percent.

The calendar tells us that we are at the midpoint of the Five Year Plan--its equator. Time itself provides an objective evaluation of the distance covered and refines and defines the program of future actions.

Our collective is called on to eliminate the lag behind the Five-Year-Plan goals which was experienced in 1981. We shall do everything possible to pay off this debt during 1983. The ambitious 7-month goal has been met. The plan with regard to new equipment has been fully implemented.

The competition in the shops for achieving maximal labor productivity and improving the qualitative work indices is being broadened. The brigade led by R. Oragvelidze, representative to the Supreme Soviet of the republic, machinist-assemblers I. Gogishvili and D. Putkaradze and dozens of other outstanding workers are setting the tone for the competition.

We need to stimulate the activity of the service groups and departments in improving the organization of production and introducing new equipment and full mechanization, the level of which has reached 60 percent. But we need to go further and proceed more actively in order to reduce the fraction of manual labor to 25 percent this year.

A major reserve for improvement lies in more rational specialization of production. We need to select those assemblies of the new series-produced machine tool which can be more economically fabricated in the specialized production facilities. Specifically, it is time to establish a definite program for more specialized production in the grinding machine plant in Tbilisi and the machine tool component plant in the village of Tsalka, which are part of our association. The lack of specialization is slowing their development.

9576
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PORTABLE PROGRAM EDITOR TO INCREASE PRODUCTIVITY OF NC MACHINES

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 7, Jul 83 pp 18-19

/Article by Engineers V. A. Vasil'yev and I. D. Sobolev: "Portable Machine-tool Control Program Editor"/

/Text/ Most programmed numerical control (PNC) machine tools, particularly those in the turning and milling groups, are equipped with the mod. N22 and N33 PNC systems. Operation of these systems has shown that along with their advantages they have some drawbacks: large expenditures associated with debugging and entering the control programs (CP). The CP preparation process is divided into two stages: theoretical calculation of the trajectory of tool motion along the contour of the part and specification of the technological regimes and preparation of the punched tape; debugging of the CP directly on the machine--optimization of the cutting and chip formation process and the tool life.

The procees of CP debugging on the machine occupies 30-50 percent of the entire preparation cycle time, since in the process of matching the SPID /system of instruments for measuring detail parts/ system and the CP the engineer-programmer returns several times to the CP preparation station and edits the punched tape. The machine downtime may amount to 40-60 percent of the shift time, which reduces the coefficient of machine utilization and reduces the output of parts.

A control program editor for machine tools equipped with the mod. N22 and N33 PNC systems has been developed and introduced into production in order to reduce the manhours involved in CP entry, raise the machine tool utilization coefficient, increase the output of parts and reduce the percentage of scrap.

The CP editor is made in the form of a portable console that connects to the PNC pedestal.

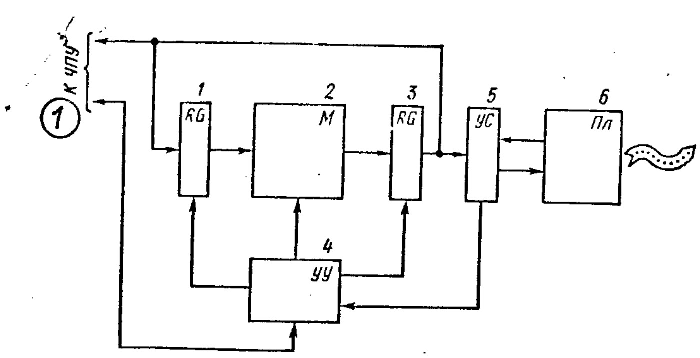
The Figure shows the block diagram of the CP editor, consisting of the input register 1, semiconductor memory (store) 2, output register 3, controller 4, coupler 5 and perforator 6. The units 1-4 form the operative memory, which is occupied with the perforator by the coupler.

The editor has five operating functions: ERASE, ENTER, READOUT, PERFORATE and STORE.

In the ERASE mode, store 2 is cleared and prepared for the reception of information. The controller 4 blocks the input register 1 and output register 3 and generates the control signals and test for erasure of the information in the store 2.

In the ENTER mode the information is entered in the CP editor memory. The controller allows the input register to operate and prevents operation of the output register. The CP is entered either from the punched tape through the photoelectric reader /PER/ of the PNC system or manually from the console of the PNC pedestal operator. The store capacity makes it possible to record 10 meters of punched tape without account for the interframe gaps.

In the READOUT mode the controller permits operation of the output register and blocks operation of the input register. Upon receipt of the signal START PER (coming from the PNC unit) the CP is transferred from the CP editor memory and is performed on the machine tool. The read-out information is fully checked with regard to modulus and address structure.



Block diagram of CP editor

1 To PNC; YY = controller; YC = coupler; Пл = perforator.

In the PERFORATE mode the controller permits operation of the output register and blocks operation of the input register and the PNC unit, which eliminates unwanted activations and displacements of the machine tool actuators. Upon startup of the perforator the coupler forms control signals that enter the controller; the CP is read out from the store and sent through the output register, the coupler and the perforator to the punched tape.

The STORE mode prevents erasure of the information in the CP editor memory in case of loss of electrical power. This is accomplished by a buffer memory powered from a battery, to which the unit switches automatically upon loss of electrical power.

Upon connection of the CP editor to the mod. N22 or N33 pedestal the PNC unit switches from class NC (unit with "fixed" logic) to class SNC (unit with input memory for storing and editing the CP), which makes it possible to prepare and edit the CP right at the machine tool workplace.

The CP editor is used in the shop as a mobile engineer-programmer workstation for compiling and optimizing individual programs for the machine tools.

We shall examine editing of the CP for a lathe with the mod. N22 PNC unit. We shall assume that the first stage of CP preparation has been performed and the information is coded on the punched tape and has the form

N 008...
N 009 *M*004 *S*006 *FE*
N 010 *X*—01700 *F* 10500 *FE*
N 011 *Z*—08000 *F* 10300 *FE*
N 012...
N 025 *X*—01000 *F* 10400 *FE*
N 026 *Z*—04000 *F* 10600 *FE*
N 027 *X*+02000 *F* 10400 *FE*
N 028...

In the process of CP debugging on the machine it was found that the tool life in frame 11 makes it possible to increase the cutting speed, while in frame 25 the cutting depth is not favorable for chip formation. For CP optimization it is necessary to replace S006 by S008 in frame 9 and F10300 by F10600 in frame 11, in frame 25 the 5 mm cutting depth should be broken down into two passes of 2.5 mm each. In this case the engineer-programmer performs the following operations:

enters the calculated CP in the CP editor memory, passing the punched tape through the PER of the PNC system;

reads the CP from the CP editor memory up to and including frame 8; enters manually from the PNC unit operator console in the CP editor memory the frames:

*N*009*M*004*S*008*FE*
*N*010*X* — 01700*F*10500*FE*
*N*011*Z*—08000*F*10600*FE*;

reads the CP from the CP editor memory up to and including frame 14;

enters in the CP editor memory the frames:

N025X—00500F10400FE
N026Z—04000F10600FE
N127X+00500F10400FE
N128Z+04000F70000FE
N129X—01000F10400FE
N130Z—04000F10600FE;

enters the CP from frame 27 in the CP editor memory, passing the punched tape through the PER of the PNC system.

As a result of the performed editing there will be in the CP editor memory the optimized program:

N 008...
N 009 M004S008FE
N 010 X—01700F10500FE
N011Z—08000—F10600FE
N 012...
N 025 X—00500F10400FE
N 026Z —04000F10600FE
N 127 X+00500F10400FE
N 128Z +04000F70000FE
N 129 X —01000F10400FE
N 130 Z —04000F10600FE
N 027 X+02000F10400FE
N 028...

Trial machining of a part is performed with the machine operating in accord with the program transferred from the CP editor memory. If the program provides an optimal machining process, the engineer-programmer switches the CP editor to the PERFORATE mode and outputs the CP from the CP editor memory to the punched tape, which remains on the machine and is used thereafter to machine the series of parts, while the CP editor is taken to another machine tool and the next program is edited.

For simple parts, not requiring complex theoretical calculations, the CP can be compiled right at the machine. For this the program frames are sequentially set manually on the console of the PNC system operator, are entered in the CP editor memory, and are then output to the punched tape.

CP EDITOR SPECIFICATIONS

Store capacity, Kbytes	4
Operating functions	ENTER, READOUT, PERFORATE, STORE

CP input	From punched tape through PER of PNC unit. Manually from console of PNC unit operator
CP output	To PNC unit, to punched tape; through perforator PL 80 (PL 150)
Time of CP storage with electrical power off, hours	100
Power required, W	250
Supply voltage, V	220 ± 10%
Overall dimensions, mm	1000x700x400

The described unit was operated experimentally with the mod. 16K20F3, 16K30F3, 16B16F3 machine tools, equipped with the mod. N22-1M PNC systems and showed stable and reliable operation.

9576
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SUCCESSFUL APPLICATION OF COMPUTER INTEGRATED MANUFACTURING SYSTEMS REVIEWED

Moscow MASHINOSTROITEL' in Russian No 3, Mar 83 pp 12-14

[Article by A. G. Rakovich, candidate of technical sciences, winner of state prize BSSR: "Automation of Technological Equipment Design"]

[Text] The constant increase in the output of industrial products, their frequent changes and the continuing trend toward complicated designs cause an intensive increase in the volume of work on the technological equipment of production. Large expenditures of money and time for designing and manufacturing accessories raise the production cost of machines and devices considerably and lengthen the preparation cycle for their production. The low standardization level of the designs of accessories, the lack of time of designers for analysis and execution of calculations, as well as the lack of technical equipment reflect poorly on the quality of the results of the work.

The territorial and organizational dissociation of design-technological subdivisions that are involved in the preparation of technological equipment for production (KB [Design Bureau] OGT [Department of Chief Technologist], the technical departments of tool shops, tool departments of enterprises, etc.), the weak ties between these subdivisions lead to labor-intensive duplication of the same data processes and frequent modifications of finished technical documentation. The individual nature of producing accessories and the high labor-intensiveness of manual programming make the use of machine tools with ChPU [Numerical Programmed Control] inefficient for manufacturing accessories parts.

All this are the reasons that designing and manufacturing accessories still remain the limiting link in the work cycle on technological preparation for manufacturing machines and devices.

The use of computers to design technological accessories and tools will reduce considerably the degree of negative effect of the above-enumerated factors on the timely and qualitative supply of production processes with the necessary equipment.

The use of computers for the automatic design of accessories was considered in the middle of the sixties by the Institute of Technical Cybernetics (ITK) of the BSSR Academy of Sciences and some other organizations in the country. As a result of many years of investigations, a theory and methods for simulating facilities and processes that take place in designing accessories, dies cutting tools and other technological equipment were developed and also a large number of invariant programming and informational components of automatic design systems (SAPR).

Program systems oriented toward second generation computers were developed by the ITK of the BSSR Academy of Sciences for the automatic design of such equipment as turning machine fixtures for parts of the lever class and accessories for housing parts, drilling fixtures, machining heavy machine building parts, fixtures for drilling flat parts, combined action dies, blanking dies with upper and lower clamps for intermediate products for cold sheet stamping, multicutting tools for various kinds of machining, etc. Some of these systems contained up to 300,000 machine instructions and operated with large data files, and included means for feeding graphic data to automatic drafting machines.

During the 10th Five-Year Plan period, the ITK of the BSSR Academy of Sciences developed a set of applied program packets (PPP) for the automated design of technological equipment: turning and drilling fixtures (Avtopris-TS), cold sheet stamping dies, multicutting tools and setting up fixtures for turning automatic machines. Special features of these packets are the modularity of their structure, the realizeability on the YeS [Consolidated System] computer, the readjustability and adaptability to changing production conditions, and the possibility of utilizing the means of machine graph plotting.

The following systems and sets were designed on the basis of "Avtopris-TS" PPP:

the "Konduktor-2YeS" system for the automated design and manufacture of fixtures for drilling flat parts;

the "Konduktor-3" system for the automated design of drilling fixtures;

a system for the automated design of fixtures for turning and grinding operations;

a program set for designing technological operations and equipment for turret-jig-boring presses;

the "Poisk" program set for the automated selection of design components for drilling fixtures for machining "solid of revolution" type parts.

The "Konduktor-2YeS" and the "Konduktor-3" systems provide an automated synthesis of designs, forming and obtaining assembly and working drawings of fixtures on drawing-plotting automatic machines (ChGA) "ITYeKAN-2M," "ITYeKAN-4," YeS7051, YeS7054, etc., and the preparation and printing

specifications and instructions on the ATsPU [Alpha-Numerical Printer] . The expanded versions of these systems automate technological preparation for the production (TPP) of fixtures and issue to the tool shop the necessary technological documentation (routing charts for machining the fixture parts, lists of intermediate products and purchased articles, lists of the costs of manufacturing the parts). Provision is made for obtaining control programs for machine tools with ChPU for machining conductor plates.

The "Konduktor-2YeS" and "Konduktor-3" systems can design fixtures for machining parts according to seven basing arrangements, and containing up to 500 machined holes. These systems are incorporated in 30 enterprises in our country.

In the SAPR fixtures for turning and grinding operations, an automated synthesis is provided, as well as design documentation for the machining of various parts of the "solid of rotation" type. The results of system functioning are assembly and working drawings of the fixtures obtained on the ChGA. A special feature of this system is the high degree of universality of its program and information modules, the considerable level of adaptability to production conditions and the content of a great number of invariant components.

The program set of design operations and equipment for the drill-jig turret presses (KRP) is provided by the YeS1022 computer and the "ITYeKAN-2M" ChGA for the following designs:

refer coordinates of forming holes of the machined details to two mutually perpendicular bases;

select the necessary type-sizes of dies, and determine their indices and positions in the turret head;

form and print the necessary text documents (tables of hole coordinates in the template, indices and positions of the tools);

determine the template dimensions and the design of levels, base selections, depressions under clamps, stop pins, etc.;

prepare template drawing descriptions and issue programs for obtaining them on the ChGA;

prepare programs for manufacturing the template on a machine tool with ChPU and issue data for coloring the template;

determine an efficient way to route when machining parts on the KRP [Monitoring Distribution Center] with ChPU and prepare the corresponding control program.

The "Poisk" program set is developed on the basis of the "Avtopris" PPP. It provides for the multiaspect search of fixtures in the data base organized in the form of a design archive available in the given production facility. Moreover, the programs implement additional design modifications of individual components of the fixtures found in the archives. A search prescription, containing data on the part being machined in great detail, serves as input into the system. The result is an index of the fixture suitable for machining the given part with instruction for additional design modification, if necessary.

The ITK of BSSR Academy of Sciences specialists are completing the development of an experimental system for a dialogue design of the fixtures intended for automated synthesis and documentation of milling and turning fixtures for machining steam and gas turbine vanes. Work is being done on creating SAPR dialogue fixtures for milling parts of other classes. The systems are based on the YeS computer and ARM-M terminal sets.

The interactive systems for equipment design provide the following:

automatic output from the computer to a graphic display of the design situation (PS) in which the designer must adopt a solution (this is preceded by a machine operation for identifying and separating the corresponding part of the digital model of the design);

a visual evaluation of the situation and correction of the design according to the adopted solution;

an image of the correcting information in the design model.

In most cases, the displays in the ARM-M do not allow showing a full graphical model (drawing) of the equipment in the true dimensions. Yet, in scaling the images, much of the information is found to be in an area that does not lend itself to analysis. For this reason, it is expedient to show on the display only that part of the information about the design that describes the conflicting PS (not solved by the algorithm). The latter may be given by the outlines of the objects being analyzed. To differentiate the components of the conflicting PS, which need to be changed from the objects that cause these situations, lines of various thicknesses and kinds are used to plot the outlines. The task of the designer is issued in a special language.

Industrial enterprises have shown great interest in the automated design of tool settings in single-bearing turning automatic machines. The set of programs that calculates the cutting conditions and sets performance standards; designs cams that control the operating cycle of an automatic machine; determines the equidistant shapes of cams and prepares programs for milling them on machine tools with ChPU, is produced by the SM-3 computer of the ARM-M terminal set. The system produces an operational technological chart of machining on an automatic turning machine, data on the cam design and programs for their manufacture on a milling machine tool with ChPU.

The "Avtoshtamp-1P" system acquitted itself well in practice. It was developed for the instrument building industry by using mathematical models and algorithms created at the ITK of the BSSR Academy of Sciences. The system is intended for the comprehensive solution of the problems in designing technological processes of sheet stamping, designing and drawing dies, and designing the technology of their manufacture and programs for machining them on machine tools with ChPU.

The use of computers for designing technological equipment is economically beneficial because it makes possible the elimination of a bottleneck in preparing for the production of new industrial products and raises the quality of the equipment being designed. Design automation reduces sharply materials and time for designing and manufacturing the equipment and, as a result, raises the efficiency of the processes for the technological preparation for producing machines and devices.

The economic effectiveness of design automation is a combination of the following effects:

reduction in labor-intensiveness of design E_1;

acceleration of preparation for production of articles E_2;

increase in standardization level of designs E_3;

increase of fixture and tool equipment in production facilities E_4;

improvement of quality of designs and documentation E_5;

higher efficiency of engineers' labor E_6;

lower cost of preparing engineering personnel E_7;

The total economic effect is expressed by the sum

$$E = \sum_{i=1}^{7} E_i.$$

The annual economic effect of reducing the labor-intensiveness of fixture design is determined by comparing the costs of the basic and introduced versions

$$E_1 = [(C_1 + E_n K_1) - (C_2 + E_n K_2)]Q,$$

where C_1, C_2 are production costs of designing one fixture of average complexity in the basic and introduced versions respectively; E_n -- norm coefficient of repayment of capital investments; K_1, K_2 -- unit capital investments in the basic and introduced versions; Q -- annual volume of designs determined by formula

$$Q = \sum_{i=1}^{m} \left(h_i' + h_i''\right),$$

where h', h'' -- number of equipment designs of the i-th group of complexity, designed per year in the process of technological operation and current equipping of production respectively; m -- number of groups of design complexity, used at the given enterprise.

The production cost of one design in the basic and introduced versions may be determined by formula

$$C_{1,2} = \sum_{i=1}^{n} t_i C_i k_i, \qquad (1)$$

where t_i -- time to execute the i-th design operation in the basic (introduced) version; C_i -- cost of executing the i-th operation; k_i -- coefficient that takes into account the overhead costs for the given operation; n -- number of design operations.

The following operations are executed in designing fixtures manually: get acquainted with the task, develop the assembly drawing, prepare specifications, detailing, check drawings, develop routing technologies for manufacturing details, calculate the coordinates, standardize technological operations, determine intermediate products and finished parts, prepare material charts, etc. The following operations are executed in an automated design: code input data, punch tape and monitor it, solve design problems on the computer and obtain text documents, obtain drawings on the automatic drafting machine, check design results.

Manual operations costs are determined by the wages of the engineers and technicians who perform these operations. The cost of machine operations are related to the cost of one hour of computer operation

$$C_c = \frac{Z_{op}}{F} = \frac{1}{F} \sum_{i=1}^{7} z_i,$$

where Z_{op} -- annual operating cost of computer; F -- annual fund of useful computer time; z_1 -- fund of basic and additional wages of the computer personnel; z_2 -- sum of annual amortization deductions; z_3 -- cost of electrical power for computer per year; z_4 -- repair costs of basic and auxiliary equipment; z_5 -- cost of maintaining premises; z_6 -- annual cost of auxiliary materials related to computer operation; z_7 -- cost of other indirect expenditures.

It is recommended to assume $Z_{op} = 0.3T_{SC}$ where T_{SC} -- computer cost per price list. Since the cost of one hour operation of the computer includes all basic and auxiliary costs, then in determining C_2 according to formula (1) for machine operations, it is assumed $k_i = 1$.

Capital expenditures in introducing the SAPR include costs K_{pr} to develop the system (preproduction costs) and the share of the costs to acquire the computer, the ChGA and other devices. Unit capital expenditures may be calculated by formula

$$K_2 = \frac{K_{pr}}{Q} + \frac{T_{sc} t_1 + T_t t_2}{F},$$

where T_t -- cost of ChGA and other equipment, acquired specially for automated design; t_1 -- computer time spent on one design; t_2 -- time spent on obtaining drawings on the ChGA for one design.

The economic effect of E_2, due to accelerating theTPP when assimilating new products, is determined by two factors: an increase in new product output during the assimilation of available funds at constant labor expenditures; acceleration of the starting of the operation of the products being assimilated in the national economy.

Effect E_{21} for the first factor is calculated by formula

$$E_{21} = \frac{S_p}{2} N_p \cdot \Delta T,$$

where N_p -- annual planned output in number of pieces; S_p -- reduction in the share of conditionally-constant costs per one product; ΔT -- reduction in preparation for the production of a new product in years due to the replacement of the manual design of the equipment by automatic design.

Effect E_{22} of the second factor is proportional to saving E_t in expenditures of live and materialized labor produced by the newly assimilated machine per unit of time, above the plan machine output, obtained due to accelerating the TPP and equal to $N_p \frac{\Delta T}{2}$, and to the size of the advance in operating new machines (as compared to the planned) which is equal to ΔT. Saving E_t may be considered proportional to the cost of a new machine, i.e., $E_t = kC_{iz}$, where k -- annual repayment coefficient.

Therefore,

$$E_{22} = \frac{k}{2} C_{iz} N_p (\Delta T)^2.$$

The effect of raising the standardization level of the designs is found by formula

$$E_3 = K_{ek} A_{pr} Q,$$

where A_{pr} -- average cost of the design in metal; K_{ek} -- coefficient of relative saving from raising the standardization level of the designs, determined, as was proposed by A. I. Baranov and V. V. Kuz'min in book "Standardization and Normalization in Machinebuilding" (Moscow, Mashgiz, 1963), by formula

$$\left[K_{ek} = K_n + K_{ets} + 0.8\ (1-K_{ets})\ x\ K_{pts}\ \frac{K_{ob} - 1}{K_{ob}},\ \right]$$

where K_n -- standardization level of equipment design, using SAPR, K_{ets} -- coefficient of production specialization and concentration of standardized components; K_{pts} -- coefficient of their repeated utilization; K_{ob} -- coefficient of the reversibility of components.

Methods for evaluating the effectiveness of the automation of the design of equipment for other components have so far not been developed. Nevertheless, there is no doubt about their importance in the total effect of using computers in designing fixtures and tools.

The practice of introducing comprehensive systems for automating designs of fixtures and tools indicates that design time is reduced to a tenth and costs of the design and the TPP are reduced to a seventh or an eighth. The economic effect calculated only according to the first and third saving sources are about 48 rubles for each design using the computer. The use of the computer in designing technological equipment has already been of great benefit to the national economy.

In evaluating the effectiveness of using computers to design equipment, one cannot not note negative factors in its use. The first one of them -- time gap between the start of the design (preparation of input data) and obtaining results from the ChGA. This gap is sometimes measured by days. At times, the production dynamics require repeated designs on the computer of the equipment for the same object with a changed input task. Thus, the designer is forced to work under conditions of returning to the same process many times which does not facilitate an increase in the efficiency of his labor. This is especially true in designing technological equipment which is characterized by the mass quantity of design tasks assigned to one designer.

The second negative factor is the higher psychological stress and rapid increase in the fatigue of the designer when working with computer

terminals as compared to traditional design methods. However, the positive effects of automated equipment design prevail over the negative ones.

2291
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FUNCTIONS OF KIEV'S INTER-PLANT COUNCIL ON ROBOTS DISCUSSED

Kiev RABOCHAYA GAZETA in Russian 7 Jun 83 p 3

[Article by L. Samoylenko under the heading "Shops Request Robots": "What's Out In the Hall?"]

[Text] About 300 industrial robots have already been introduced at Kiev enterprises, and the number of constantly increasing. This has been facilitated in considerable measure by the scientific methods council operating under the party gorkom. Created in accordance with the CPSU Central Committee decree on steps to increase the production and broaden the use of manipulators in branches of the national economy, it directs the research of scientists and specialists and generalized achievements in robot manufacturing.

Three years ago, each of 32 plants tested averaged two manipulators. They "ran" heat furnaces, serviced electroplating baths -- working where conditions were hazardous to man, in other words.

The production association imeni S. P. Korolev went further: manipulators were installed in machining and were entrusted with releasing a variety of small-series parts. But after a month or two, the plant accounting office sounded the alarm. It turned out that so much was being spent on preparing the robots for operation, servicing and adjusting them, that one could have just opened a new sector, taken on the lathe or milling machine operators and been done with it!

So where are the touted advantages?

"Robots must work in a collective with others of their kind," was the conclusion arrived at in the association's shops. And this appraisal turns out to be correct. But does that mean that machines are able to completely displace people? Under production conditions? The operations involved in servicing machine tools and various other equipment seem simple so long as they are done by people. But in fact, they are complex and sometimes cannot be robotized, that is, people cannot be replaced by machines. This is why, although manipulators have long since settled into stamping and pressing operations at the Korolev plant, the idea of creating a [fully] robotized sector is still in the formative stage.

Nearly all capital enterprises which have embarked on the path of introducing these automated innovations have encountered these or similar problems. Specialists at the "Krasnyy ekskavator" and "Leninskaya kuznitsa" plants have turned out to be in the best position. They considered using advanced welding equipment and were assisted by the flagship in this field, the Institute of Arc Welding imeni Ye. O. Paton of the UkSSR Academy of Sciences. Working with its scientists, they found an optimum variant for introducing a contact-welding robot at the "Krasnyy ekskavator" and a companion arc-welding robot at the "Leninskaya kuznitsa." This is now benefitting the plants, and considerably so. The "Kommunist" has far outstripped other enterprises. This production association uses robots in the foundry, stamping, plastics and machining shops.

Under the plan, the city was to have introduced 103 pieces of robot equipment last year, and it actually introduced 146, with an overall economic impact of 315,000 rubles. On the initiative of the party gorkom, a scientific methods council for robotization was set up under the leadership of Doctor of Technical Sciences G. A. Spinu, professor at Kiev Polytechnical Institute.

"Quite a few questions came under the purview of the council," says Gleb Aleksandrovich. "The main ones were: coordinating robot development and use, making specific recommendations concerning this, helping train specialists, and others. The council commissions began working on a cross-section of these tasks. We first advance the goal of creating a lively interest in robots. As a matter of fact, a true specialist is always drawn to innovations. But experience indicates that the experience of plant engineers in this so to speak delicate field was far removed from practical production tasks. People were going "by feel," by trial and error....

Still, the fewer the mistakes the better. The lectures, seminars and conferences conducted by the council enabled us to direct engineering thought into the proper channel. The Korolev workers mentioned before created a special bureau for introducing robot-technological complexes, and in so doing, took on a job very important to the plant: it scrupulously sought out bottlenecks which could be opened up more conveniently, profitably and promisingly precisely through the use of robots. And they did find such points. For example, parts are now electroplated automatically. The process is controlled by computer. The enterprise recently purchased a large number of manipulators. Prior to the end of the year, after a detailed study of leading experience in the branch, they intend to create a new robot-technical line here. It is estimated that the greatest return will occur in stamping.

So, we have not individual mechanisms, but lines, sectors and complexes, which is a step forward towards higher production organization using robot equipment.

Scientists assert that we are on the threshold of a second scientific-technical revolution in which robots will be in the leading detachment.

"A new branch of knowledge, robot engineering, is being formed," says Professor G. A. Spinu. "In parallel with it is robot manufacturing, a branch of industry. Their merging will bring great benefits."

By using automation, the association imeni S. P. Korolev has increased labor productivity two- to three-fold in individual sectors just in recent years. Nothing else could have achieved this. But we must go further. This is why they have set a goal of creating GAP's, flexible automated production facilities, in which all operations will be controlled by computer. The machine program will contain data on the number of blanks, their delivery to the shop and machining (including with the use of robots) and packaging, that is, the entire technological chain.

The GAP's have a broad range of internal mobile restructuring. In small-series production, this is an invaluable quality. Let's say a plant has been producing one type of machine for many years. The design has been constantly improved, but the equipment in the shop remains the same. A moment arrives when both the machine tool and the line must be renovated. This sometimes costs millions of rubles. Machinery obsolescence or aging has now increased considerably. What was quite suitable yesterday will not do tomorrow. Should we hurry up with the renovation, with tearing down the old and building the new?

That is a question for the very near future. And the answer will be found faster where robot-technological complexes are already being mastered, where we have succeeded in using flexible automated production facilities. In this regard, incidentally, the Koroleva workers plan to introduce another 40 robots by the end of the five-year plan.

But how many, total, are there at city enterprises? The scientific methods council drew up a questionnaire to find out the situation and determine ways of developing robot engineering. The picture which emerged was quite mixed. There are plants without even a hint of robots. Some have robots of obsolete design. Robots are operating promisingly at the radio plant and in the "Eketronmash" and "Kommunist" production associations. At the latter, the dynamics are as follows: in 1981, it had 28 robots and manipulators; last year, the number had increased by 16, this year the increment will be the same, and during the remaining two years of the five-year plan, 27 and 32 more will appear, respectively. In sum, shops of the association will have an astonishing fleet of 119 units of this advanced equipment. This is considerably more than at other city enterprises such as, for example, the "Bolshevik," "Medapparatura" and imeni Leps. Light industry represents a significant reserve for this. Its factories must begin without delay to develop and introduce manipulators to sew individual clothing subassemblies and to assemble shoes.

An analysis of the situation with regard to using robots also indicates that this process is moving along two lines. The entire technical policy is set up in the branch. It is the ministries and departments which resolve such tasks. But there is also the scientific methods council, which is a public organization which has assumed the coordination of actions among the plants.

The question is, how to coordinate council activity with ministry and department plans. Does the scientific methods council have a sufficiently complete picture of the innovations in instrument making, in the production of excavators, in welding, in footwear sewing? And the reverse, have the ministries concerned been informed as to which Kiev enterprises can be substantially assisted by this public organization and influenced to use robots?

Thus far, there is no such solid communication, but it has become necessary. We need to examine the problem of perfecting robot control systems. They sometimes do not meet specifications. There are no fittings for many manipulators. They are not standardized and are manufactured under primitive conditions. We cannot wait while the robot supplier plants are making them this way.

The council can concentrate its efforts on training personnel. Thus far, only the polytechnical institute is giving student lectures and setting up the retraining of specialists for robot engineering. That is not enough. We need better propaganda, increasing the number of meetings and seminars.

Robots have entered the hallways of many enterprises. But in order for them to operate a full strength, they need effective assistance.

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BRIEFS

MOLDAVIAN COUNCIL FOR ROBOTICS--Kishinev--A scientific-methodological council for robotization and robotics has been established under the republic council of scientific-technical societies (NTO). Its members consist of scientists, representatives of leading enterprises and production associations, workers of the republic NTO board and state institutions. The council is to produce a comprehensive plan for introducing robot manipulators into the enterprises of the branches of the republic's economy in the Eleventh Five-Year Plan. Counselling offices will be set up in Kishinev, Tiraspol and Bel'tsy. To train engineers in the field a department of automation and robotics is to be organized at the people's university House of Technology and a republic scientific-practical conference on "Robotization and Robotics" will be held in late 1983. The new scientific-methodological council expects republic ministries and departments as well as associations, enterprises and organizations to actively involve themselves in its work and to take part in implementing the directives of the 26th Congress of the CPSU on introducing into production program-controlled automatic manipulators. These will eliminate low-skill, monotonous manual labor as well as work under difficult and unhealthy conditions; they will allow the creation of fully automated sections, shops and production lines in branches of the national economy. Industrial robots must first find wide application in machine building, light industry, the food industry and in transport. It is important to work purposefully to raise the machine-to-worker ratio, introduce comprehensive mechanization and automate production processes and reduce in every industry the number of workers engaged in manual labor. [Text] [Kishinev SOVETSKAYA MOLDAVIA in Russian 22 Jun 83 p 2] 12258

VERSATILE ROBOTS--The automatic manipulators whose series production has begun at the Chuguyev experimental precision tools factory will enable individual lathes, milling and grinding machines to be brought together into robotized complexes. The first consignment of the devices was dispatched today to agricultural machinebuilding enterprises in the Russian Federation and the Ukraine. Each robot installs and secures the workpiece and when the processing is done passes it along to another machine for the next operation. The actions of the robot and the machine tool are coordinated by automatic program control, thus enabling one operator to service up to ten machines. Before the end of the current five-year plan the enterprise will substantially increase the capabilities of its manipulators. They will "assimilate" the specialties of stampers, welders and endowing them with the ability to do stamping, quality control workers. [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 2 Jul 83 p 2] 12258

ROBOTS AT WORK--The All-Union Scientific-Research, Planning and Design Institute of Hoisting and Conveying Machinery (VNIIPTmash) has finished testing a new automatic pneumatically-driven manipulator. This robot will work with loads of up to 100 kgs at sites where for some reason the use of electric machines is undesirable. Electromanipulators, however, possess certain advantages, which is why the institute is simultaneously working on an apparatus that will cope with 400 kgs. Even more powerful will be a hydraulic manipulator now on the drawing boards here. Employed at various enterprises are quite a few loaders, whose work is seldom sufficiently mechanized and its efficiency is intolerably low. Another unexpected but characteristic example: a lathe-operator spends up to half his worktime on loading and unloading operations. The new machines are called upon to free skilled workers from unproductive manual labor, especially since positive results have already been achieved in their creation and introduction into production. The first automatic loader, created by the institute's scientists, won a medal of the Exhibition of USSR National Economic Achievements, and the "Mosprommekhanizatsiya" plant organized its series production. The robot soon appeared at enterprises in the capital, the Ukraine and Siberia and has earned high praise. Indeed, the ShBM-150, so named by its designers, easily handles loads of up to 150 kgs, operates both in push-button and automatic mode and has a fairly wide range of speeds. Moreover, this "crane" does not sway its load, delivering it in a rigid claw at the required angle. All this permits it to service four machine tools simultaneously. The apparatus can be set up in different ways, as a mobile unit, a wall fixture or a column, allowing it to be used in a wide variety of industries. By increasing productivity and improving production standards a single such robot saves over 8,000 rubles annually. VNIIPTmash's scientists are trying to preserve and multiply the capabilities of the ShMB-150 in new and promising models. Tests show that they are on the right track. [Text] [Moscow MOSKOVSKAYA PRAVDA in Russian 24 Jul 83 p 1] 12258

ROBOTICS ENGINEERING CADRES--Honors students A. Levshin, S. Sergeyenko and S. Stel'mak, after studying a year at the faculty of machine-building, have been enrolled as second-year students at the country's first faculty of robots and robotics which has just opened at the Belorussian Polytechnic Institute. Their classmates will be 25 other of the best students from the BPI, the Belorussian State University imeni V. I. Lenin and the Institute for the Mechanization of Agriculture. The decision to admit them all as second-year students stems from the need to accelerate the training of specialists in modern technology in order to reduce the severe shortage of such personnel currently felt by the republic's enterprises. Meanwhile, the selection committee has begun taking applications from school graduates who dream of becoming engineers in automated industries. Three hundred of them will be admitted as first-year students in four specialties. After 5 years they will be creating, then working in automated, almost peopleless shops, in scientific-research and experimental-design organizations and in enterprises engaged in the development and manufacture of manipulators. "The republic is implementing widely and according to plan a far-reaching, comprehensive robotics program," a BELTA correspondent was told by G.I. Khutskiy, chairman of the Belorussian methodological council for generalizing and disseminating advanced know-how and coordinating work on automatic manipulators. "The

program calls for the introduction in this five-year plan alone of not less than 2,000 robots at Minsk plants. This will raise productivity 2-3 times and produce an economic effect of over 7 million rubles. The opening of the new faculty of robots and robotics systems is the final link in the logical chain "designer-manufacturer-operator." The new industry will now be able to draw on a pool of highly-qualified specialists." [Text] [Minsk SOVETSKAYA BELORUSSIYA in Russian 20 Jul 83 p 2] 12258

ROBOT SPECIALISTS--Minsk--The first department of robots and robotics systems in the country has opened at the Belorussian Polytechnic Institute. It will annually graduate 300 engineers in four specialties whose duties will involve the creation of automated, practically peopleless shops and the development and creation in metal of industrial manipulators. [Text] [Moscow GUDOK in Russian 17 Jul 83 p 1] 12258

MINIROBOTS--Nal'chik--The Nal'chik Experimental factory for special technological equipment has begun series production of automatic manipulators of the "mini" class. These industrious and reliable minirobots can do both assembly work and stamping. No less than 1,200 manipulators will be produced by the plant before the end of the year. [Text] [Moscow GUDOK in Russian 24 Apr 83 p 1] 12258

FROM EXHIBITION TO SHOP--Moscow--Last year the exhibition "Special Technological Equipment" at the Exhibition of USSR National Economic Achievements demonstrated a specialized manipulator for arc welding hard-to-get at places in large-size constructions. The manipulator was created by specialists of the All-Union Design and Technology Institute for Heavy Mchine Building. The manipulator inserts the welding heads inside the workpiece, starts welding and without human participation sees the process through to completion. At present the novelty has already been introduced in several Mintyazhmash plants. It has not only led to a one and a half to twofold increase in labor productivity, but has done away with the heavy manual labor involved in welding semi-closed compartments of large-size constructions. [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 7 Jun 83 p 2] 12258

ALL-PURPOSE ROBOTS--Mogilev--The first group of "Dnepr-10" robots has come off the assembly line at the "Tekhnopribor" plant in Mogilev. The new equipment distinguishing feature is its versatility--it can take part in assembly, metalworking, painting and other operations, and fits neatly into automatic lines. Its memory stores up to a hundred programs. [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 29 May 83 p 2] 12258

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